



Assessment of the Rose-Hulman Leadership Academy

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Abstract

Giving students the ability to be entrepreneurial leaders is a potentially valuable outcome for an engineering program. Entrepreneurial leadership consists of communication, teamwork, and problem solving skills that are important to careers in STEM fields, including engineering. For engineering, in particular, entrepreneurship and leadership skills relate directly to accreditation outcomes that every undergraduate engineering program must address. In this study, we describe the assessment of a three day leadership academy program at a small, technical school in the Midwestern United States. Activities in the academy consisted of seminars on leadership styles and communication comingled with problem solving and teamwork activities in which students were asked to analyze and apply the ideas they had learned. This academy is part of a grant from the Kern Entrepreneurial Engineering Network, and activities were tailored to address specific outcomes from that grant. Multiple forms of data were collected to assess the student experience at this leadership academy. To assess the application of ideas from seminars during activities, program facilitators, consisting of faculty and attendees of previous iterations of the academy, were asked to fill out open-ended assessment forms. These forms were designed to highlight ideas that students were implementing well, and areas that were in need of improvement. Additionally, pre and post surveys were administered to all program participants, measuring entrepreneurial mindset and student perceptions of program outcomes. Finally, voluntary semi-structured interviews were conducted after the leadership academy concluded. These interviews addressed outcomes that were not covered by surveys and facilitator comments, and provided further insight into how students perceived the academy. Our analysis of results shows that academy activities positively influence student skills in teamwork, communication and problem solving.

Introduction

Skills related to entrepreneurship and leadership are common topics in the discussion of developing engineering education curricula and assessments^{1, 2, 3, 4}. While exact definition of both entrepreneurship and leadership vary from publication to publication, we define entrepreneurs as individuals with the skills necessary to explore and develop new product ideas and leaders as those with the ability to guide a group of people to the accomplishment of a task. Regardless of variations in how both of these terms are defined, a common thread among what is necessary to be an entrepreneur or a leader is the ability to work effectively with others in order to solve problems. In this paper, we discuss the implementation and assessment of a Leadership Academy that aims to build communication, teamwork and problem solving skills in undergraduate students at a technical university. The academy is part of a larger, entrepreneurial-focused program run through the Kern Entrepreneurial Engineering Network (KEEN). While the academy and its assessment involve some outcomes outside of communication, teamwork and problem solving, we decided to focus on these three outcomes for this paper due to their prominence in the academy and their application to outcomes in engineering education as a whole. This paper will also highlight how the utilization of multiple methods^{5, 6} can aid in the assessment of a program such as the academy.

The Rose-Hulman Leadership Academy program

The Rose-Hulman Leadership Academy was developed in 2008 to provide students with a grounding in leadership theory while also providing them with opportunities to apply this new knowledge in hands-on activities. In student surveys, leadership was identified as an outcome that was important to graduates in their careers but received little formal training during their undergraduate experience. For this reason, a group of faculty, staff, and administrators developed an Academy, based on models used at other colleges and universities. The first Academy was offered in 2008 for 16 students. Since that time, the program has grown. In 2014, 52 students were enrolled (after review of a formal application) in the three-day Academy.

The most recent iteration of the Leadership Academy consisted of three days. The first day included introductions of students and facilitators, the introduction of a basic personality inventory and a team puzzle solving activity in which groups were asked to consider the personalities of their teammates while working with them to solve a logical puzzle. The second day consisted of ropes course activities, in which students worked in teams and had to approach a number of physical problems through teamwork and communication. Students had some instruction from facilitators for each activity, but were not told how to go about solving any of the activities. For example, in one activity, students were split up into groups and placed on “islands,” or wooden platforms. They were given a set of wooden planks of different lengths, and had to work together to move the whole team to the “exit” island. On the third day of the academy, students were given instruction on different leadership theories (situational, transformational and servant)^{19,20,21}, and were asked to reflect on how their ropes course experience related to the different leadership styles they just learned about, and about important lessons learned during the academy.

Purpose of assessment

The purpose of the assessment plan developed in this study was to investigate how the Leadership Academy activities tied to the outcomes of the KEEN program. Additionally, this assessment was used to gauge the student perspective on the leadership academy and identify aspects of the academy that students found important to their current academy pursuits and future careers in STEM fields. Outside the context of the KEEN program, the Leadership Academy and this assessment plan are potentially valuable for those who are considering running similar communication, teamwork and problem solving workshops, as this paper overviews both the activities within the academy and the potential value that they have to communication, teamwork and problem solving related outcomes.

Background

This section will overview the objectives of the KEEN Entrepreneurial Mindset grant, how the Leadership Academy activities fit within those objectives, and how the objectives of the academy align with other work in engineering education and entrepreneurship.

Entrepreneurial mindset

According to Kriewall and Mekemson⁷, the Entrepreneurial Mindset (EM) consists of a set of abilities that will prepare graduating engineering students for any engineering career path, whether that career includes true entrepreneurial ventures, entrepreneurship (i.e., taking leadership roles in established companies), or work as staff engineers who function on teams to develop products and solve problems. In further defining the attributes of the entrepreneurial mindset, Kleine and Yoder (page 59)⁸ break EM down into seven outcomes:

- Effectively collaborate in a team setting.
- Apply critical thinking to ambiguous problems.
- Construct and effectively communicate a consumer-appropriate value proposition.
- Persist and learn from failure.
- Effectively manage projects through appropriate commercialization or final delivery process.
- Demonstrate voluntary social responsibility.
- Relate personal liberties and free enterprise to entrepreneurship.

While these objectives have been modified and updated within KEEN⁹, though not published in research, the importance of communication, teamwork, and problem solving continue to be emphasized in student outcomes defined through the network. As the Leadership academy focuses on communication, teamwork, and problem solving, outcomes related to these topics are the main focus of the assessment plan described in this paper.

Usefulness in the context of engineering education

Outside of KEEN-related publications, communication and teamwork are defined as important factors in developing and assessing entrepreneurial skills in engineers^{10,11} and in general.^{12,13} Additionally, communication, teamwork and problem solving are essential components of ABET's a-k outcomes.¹⁴ The development of programs for^{15,16} and assessments of^{17,18} these skills continues to be a focus on engineering education publications.

Methods

Multiple methods were used to assess the Leadership Academy. An overview of all of these methods is shown on Table 1. Two surveys were given to students who participated in the academy before and after the completion of academy activities. The first was a survey with items tailored to each of the most recent KEEN outcomes called the Entrepreneurial Minded Learning (EML) survey. The EML survey consisted of five point Likert scale questions. The second was a survey with questions tailored to the academy itself, including short response answers about academy activities. The Leadership Academy Pre and Post surveys are versions of the same survey asking students questions related to the Academy. The post survey added some reflective questions about the Academy itself. There are four types of questions in this survey: four choice Likert scale questions asking students their beliefs on leadership; multiple choice, multiple answer prompts asking students about their personal attributes related to leadership; five choice

Likert scale questions asking students about beliefs in their abilities; and short response questions related to leadership and the academy itself. Both surveys were completed online.

In addition to survey responses, other assessment data was collected both during and after the academy. During ropes course activities, facilitators were asked to fill out a rubric for each team during each activity. This rubric prompted facilitators to remark upon how each team performed in terms of communication, teamwork and problem solving by providing both positive results and areas in need of improvement. Additionally, on the final day of the academy, students were asked to participate in a reflective activity. During this activity, students were given a picture taken of a team (not necessarily theirs) on one of the ropes course activities, and in a group, comment on and write down reflections of their day on the ropes course in relation to new ideas they learned in the academy. Finally, some students were asked to participate in a post-academy interview. These interviews were semi-structured, and asked students to discuss their academy experience and how it related to their current and future lives.

Rubrics were coded by grouping evaluated by team (there were three teams of 16) and response type (communication, teamwork and problem solving). The evaluations were then condensed into tables to get an overview of how each team performed on the day, as a whole, and to identify themes across teams. Interviews and reflective activities were coded using open coding techniques²². These techniques allow for ideas to emerge from the student responses by starting with no code book before analysis, and grouping similar responses together to create new codes.

Table 1: Overview of Leadership Academy Assessments

Assessment	Purpose	Implementation
EML Survey	Assessment of KEEN outcomes	Pre and post Academy
Leadership Academy Survey	Assessment of student experiences during the Academy	Pre and post Academy
Ropes Course Rubrics	Assessment of student communication, teamwork and problem solving	During Academy
Reflective Activity	Assessment of student application of Academy instruction to Academy activities	During Academy
Student Interviews	Assessment of Academy outcomes based on post-Academy student perceptions	Post Academy

Survey data

In total, 35 students responded to the EML pre-survey and 17 students responded to the post survey, of which 14 took the survey both times. Responses to the EML survey showed no significant changes between pre and post responses for any KEEN outcome. This could

potentially be due to a low population of students to draw from, and not all students responding to both iterations of the survey. More students took the pre-survey as it was a required survey for incoming freshmen the fall that the academy took place.

For the Leadership Academy survey, there were 20 responses to the pre survey and 20 responses to the post survey. Student identities were not tracked across these surveys. The first group of questions are three questions asking students to Strongly Agree (4), Agree (3), Disagree (2) or Strongly Disagree (1) with statements about the nature of leadership. Figure 1 shows the summary of those results. These results contain a significant change in student views about the nature of leadership (Unpaired t-test, $p = 0.05$), with students being more likely to believe that leadership is a learned skill after the academy and less likely to think it is an innate ability. These results are shown in Figure 1. Note that, while the changes were significant in a statistical test, the sample size for the leadership academy was very small.

In the second type of Likert Scale questions, students were asked to rate their ability in teamwork-related tasks as One of the Best (5) Above Average (4) Average (3) Below Average (2) and One of the Worst (1). None of the changes in these results were significant.

Multiple choice multiple response items asked students whether one of six traits--Character, Communication, Emotional Intelligence, Interpersonal Skill, Organization and Vision--were strengths and weaknesses before and after the academy, and whether they were improved and were beneficial to them after the academy. While the sample size was too small to make any claims of significant change, it is interesting to note that students reported fewer weaknesses after the Academy than they did before (sum of weakness tallies across all students was 47 before and 35 afterwards), while strengths remained about the same (70 before and 71 after). Figure 2 summarizes these results.

In their responses after the Academy, students highlighted the traits that they think were most improved after the Academy and those that they thought were most beneficial to them. Note that students felt that the Academy most improved their Communication, Emotional Intelligence, Interpersonal Skill and Vision traits. These are also the skills that students tended to value the most. Figure 3 Summarizes these results.

There were also short response questions in both pre and post surveys. In the Pre survey, students were asked which areas of their life leadership training would help them the most. Students saw leadership training as useful in a different areas of their life. One student responded: "Broad: Anywhere, Specific: Work, Personal Projects, Academic Projects, Trips, Volunteering." Another said "Running clubs, speaking up in a general public, job interviews, job related experiences." Yet another mentioned multiple aspects of their life, stating "Communication, job-searching, job interviews, intelligence, experience, meeting new people." Students frequently mentioned general communication ability, coursework, future jobs and academic and professional organizations as places where leadership training would help them.

Figure 1: Student beliefs about the nature of leadership before and after the academy. See above for further information.

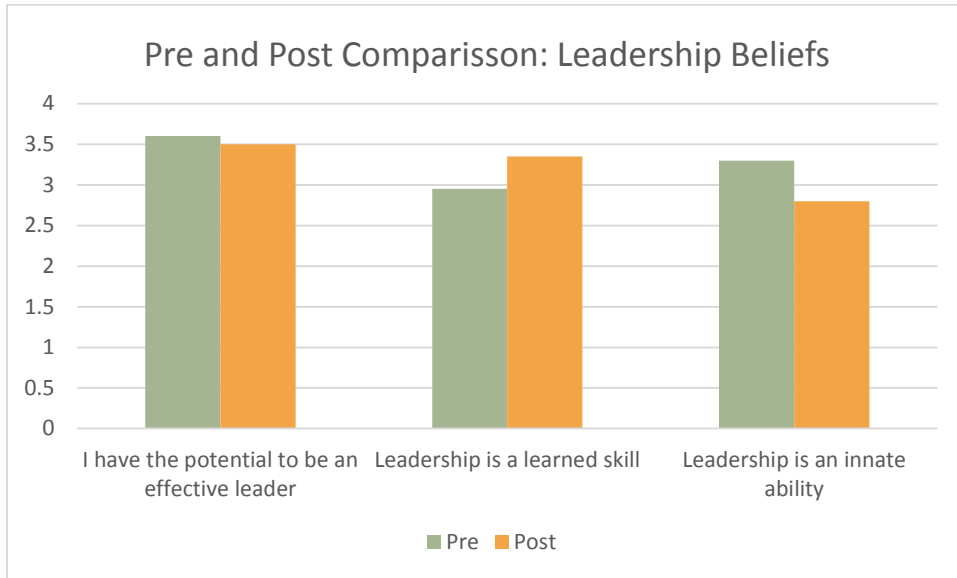
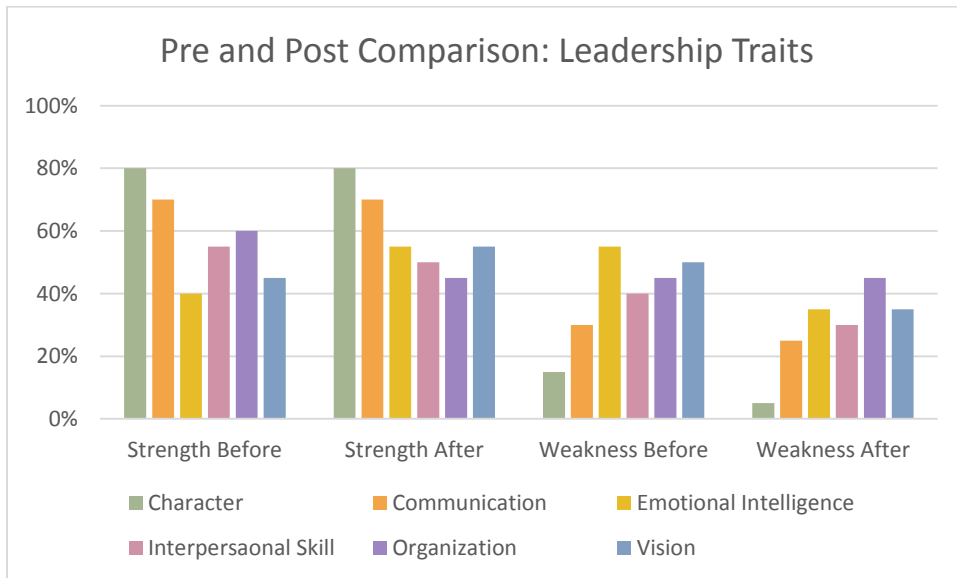


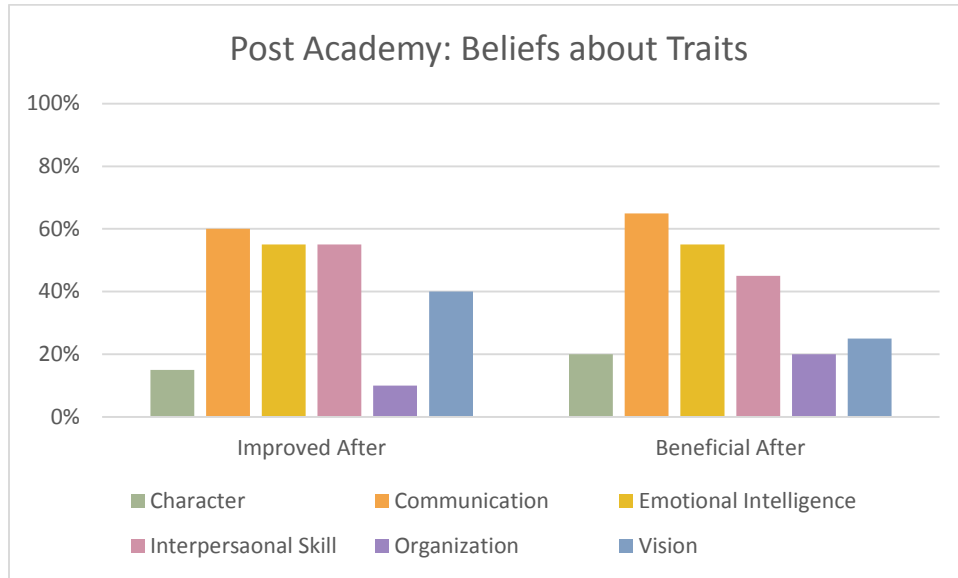
Figure 2: Perceived leadership trait strengths and weaknesses before and after the academy. See above for further information.



In the post survey, students were asked the same question. Students, again, focused on the general usefulness of the training. They also integrated some ideas from the academy in their rationale. One student wrote:

I could use this in daily life to improve my friendships through servant leadership. Also, I am a leader in several organizations, and I intend to teach my groups what I have learned so that I can become better leaders and examples on campus.

Figure 3: Beliefs about which leadership traits improved and were most beneficial after the academy. See above for further information.



Drawing on the idea of servant leadership and meeting the needs of others you work with, another student commented:

This will help me in my future as we will be working with others and where disagreements are inevitable. I learned how to approach these problems and ways to get around them without compromising someone's ideas.

Here, the student has applied experiences in the Academy to parallel experiences in real life, discussing how the academy experience could aid in teamwork and the sharing of ideas between people with differing opinions. In another response, a student noted that they felt more confident after the Academy:

I think it has benefited me in classes, group work, self-confidence, and even interviewing skills. I noticed a huge change in myself after completing the course.

Students were also asked to describe their rationale for their beliefs about which traits had been improved and were most beneficial after the Academy.

In things that students felt they improved upon because of the Academy, their discussion focused on communication, teamwork, emotional intelligence and interpersonal skills required for leadership.

I learned more about when to lead by following and being a servant rather than lead by direction. I also learned to step back so others can have an opportunity to grow as a leader.

In the above quote, the student ties in ideas they learned about servant leadership to describe how their communication and interpersonal skill has improved.

After learning about different personalities I became more aware of them and others emotions. I also learned that we may see them as several characteristics that they don't quite see that in themselves and we have to communicate about that information.

The student who wrote the above quote tied how knowledge of emotional intelligence and interpersonal skills via understanding personality types can make him or her a better communicator. Similarly, another student focused on working with others in their response:

Many of the activities in the Leadership Academy taught me about the roles each person plays in a group and how to solve potential problems that arise in groups. As a result, I learned about my role and also how others' roles should be tweaked.

Again we see a student who has gained new perspective on how to interact with others through the academy.

Ropes course rubrics

Rubrics consisted of a table in which observers wrote down notes on where students performed well and needed improvement in three areas: communication, teamwork and problem solving. Though scheduling variations didn't allow for each team to complete every activity, or a facilitator to record every activity a team participated in, most activities were observed. The result of the collection process was 24 completed observation sheets.

Some common themes emerged from these data sheets. They included:

- Encouragement: Participants in all groups were encouraging of one another.
- Planning in the problem solving process.
- Frustration: Each group had moments where frustration led to disruptive moments.
- Non-verbal communication: This was a challenge at some point for each group.
- Ignored or lost ideas: Participants often talked over one another or didn't consider ideas from everybody.

Students were strong in the area of providing encouragement and respect to their fellow team mates, even though communication and teamwork abilities demonstrated during the academy varied among groups. Students also demonstrated planning in problem solving situations across all groups.

In terms of weaknesses demonstrated by students, each group displayed instances of frustration leading to disruptive or unproductive moments. Each group also struggled with non-verbal communication, at some point. Finally, and most prominently, viewpoints and ideas were ignored and lost by each group due to people talking over one another and not listening to ideas others proposed.

Reflective activity

The reflective activity consisted of students submitting reflective notes on photographs from their ropes course experiences. In all, we identified 176 different reflections from the activity. The themes that we identified within these codes were as follows:

- Problem Solving: Students discussing ways they went about solving problems or accomplishing tasks.
- Communication: Students discussing their experiences trying to communicate ideas.
- Motivation: Students discussing how they were motivated by each other or themselves.
- Types of leadership: Students discussing one of the three leadership styles they were asked to relate to.
- Relating: Students discussing aspects of interacting with others.

In the section below, we will summarize the ideas represented by these codes. Each summary is accompanied by examples of student reflections where those codes were applied, so as to provide context for that summary.

Problem Solving

In codes categorized into the theme of problem solving, there were three distinct types. Adapted was applied when students discussed changing the way they worked based on new circumstances or challenges. Organization was any mention of planning or organizing (or lack thereof). Finally use ideas was the discussion of applying ideas that students had to solve a problem. Students discussed adaptation in terms of learning from mistakes, figuring out what to do because of weather conditions, and how different people had different needs for accomplishing the same task. Organization was often discussed in the form of disorganization. Disorganization is something that was mentioned in a number of facilitator observations during the ropes course, which manifested through talking over one another and not discussing strategy amongst the entire group. Other times, students discussed planning and strategizing with one another. In these reflections, the topic is present but not as prevalent. Students also discussed the application of ideas that arose during the activity on two occasions.

Table 2: Examples of problem solving codes. Total number of each code applied shown in parentheses.

Adapted (11)	Organization (7)	Use Ideas (2)
<p>Adapted methods of completion from mistakes. Learned to adapt due to weather.</p> <p>The part of the group must adapt their strategy as they move members off the island.</p> <p>What worked to get a teammate toward the center does not work to move them away.</p>	<p>No organization: too many people doing things at once.</p> <p>Unorganized overall strategy resulted in success.</p> <p>Coordinating with others.</p>	<p>The first few people needed more direction while the late people understood what to do better.</p> <p>People had to listen to other ideas and motivate others to attempt to walk across to the next island.</p>

Communication

The communication theme developed into two ideas: nonverbal communication and communicating ideas. Nonverbal, as the name suggests, is any mention of communication without words. Communicate ideas is the mention of the successful or unsuccessful exchange of ideas. Some students noted that nonverbal communication was a challenge. This corroborates some facilitator observations that students struggled with nonverbal communication. Communicating ideas, and the different ways of doing so, was discussed on many different reflective statements. Sometimes this was in the form of inability to communicate, or lack of listening.

Table 3: Examples of communication codes. Total number of each code applied shown in parentheses.

Nonverbal(7)	Communicate Ideas (19)
<p>Non-verbal communication required.</p> <p>No verbalization = harder to explain ideas.</p> <p>Adapting on not being able to talk.</p>	<p>Captain gave direction; people engaged through action and discussion; followers and captain exchanged ideas and coordinated who would do what</p> <p>The people are putting out ideas and being knowledgeable.</p> <p>People in the middle did not listen to the people on the outside.</p>

Motivation

We placed codes for motivation into two categories: those relating to personal motivation, and those relating to support and encouragement. Personal motivation is the discussion of internal motivation factors. Support and encouragement is the discussion of providing others with motivation. Personal motivation was mostly tangentially mentioned, as in the quote mentioning focus *and* teamwork. By far, the most applied code in this analysis was support and encouragement.

Table 4: Examples of motivation codes. Total number of each code applied shown in parentheses.

Personal Motivation (5)	Support and Encouragement (41)
Motivation through focus and teamwork	One person couldn't get up the whole clime, as a group we weren't able to motivate her enough.
Finding original motivation.	
Motivation is a big deal in the jumping part.	Being scared is totally fine, but it is the group's responsibility to encourage the person.
	The people in the middle had to show the people on the outside that it was possible and that they could do it.

Leadership styles

Discussion of leadership styles was a central part of this reflective activity. Reflection on different leadership styles was often done in reference to other ideas. Transformational leadership, in the quotes shown in Table 5, is discussed in relation to encouragement and communication. The examples of situational leadership relate to personal space and comfort. The examples of servant leadership relate to teamwork, support and personal space. Students also related to the defined types of leadership on their own, as shown by the third quote in each column of the table.

Table 5: Examples of Types of Leadership. Total number of each code applied shown in parentheses

Transformational	Situational	Servant
<p>Transformational approach: Whenever someone got on the whale watch, everyone would laugh and be happy. This shows signs of motivation and encouragement.</p> <p>Transformational – You had to engage with one another in order to figure out what their needs are.</p> <p>Transformational: 1st person understood how it moved and shifted with weight and could help direct others because of it.</p>	<p>Situational: Leader may have to physically touch partner to help achieve goal.</p> <p>Situational approach – Different approaches to complete task based on what was comfortable to them.</p> <p>There are times to step forward and times to stay quiet: situational leadership.</p>	<p>Servant leadership: helping partner up to each common goal: get to the top.</p> <p>Servant leadership: People holding each other in slippery situation, supporting others when they are uncomfortable.</p> <p>Servant leader approach: Everyone had to listen to each other to figure out their needs.</p>

Relating

Students discussed different aspects of relating to one another. We broke these discussions down into four codes: teamwork, awareness, personal space and emotions. Teamwork was general discussion of working with other people. Awareness was the mention of important factors to consider in a situation. Personal space was the discussion of personal boundaries in any context. Emotions was the mention of any emotional state in reflection. Teamwork was applied when students mentioned aspects of working together, even when it was not effective (as in the second example). Awareness was something that was mentioned tangentially and only twice. Personal space was discussed quite often. It appears that, because many of the activities required students to push the boundaries of how physically close they might normally be to one another the experience left a lasting impression on them. Emotions were also reflected on by some students, including finding activities fun, or finding interaction tense, stressful or frustrating.

Table 6: Examples of Relating. Total number of each code applied shown in parentheses

Teamwork (13)	Awareness (2)	Personal Space (19)	Emotions (6)
<p>Everyone was involved and worked toward the same goal.</p> <p>Assigned leader could not corral followers effectively</p> <p>Building sense of collective ownership/responsibility.</p>	<p>Become more aware!</p> <p>Alertness of surroundings.</p>	<p>Respect of space and comfort level of others, learned to trust others in our personal space and do what needed to be done.</p> <p>People who didn't seem to trust the group landed poorly and almost fell through.</p> <p>Different approaches to complete task based on what was comfortable for them.</p>	<p>A lot of laughing and smiling</p> <p>Tense and stressful.</p> <p>Frustration between divisions of ideas in the group.</p>

Interviews

There were three students who took part in follow-up interviews. All were female. The pseudonyms assigned to these students were Rebecca, Tina and Patricia. Rebecca is a senior in biomedical engineering. Tina is a freshman who is currently undecided on her major. Patricia is a sophomore majoring in mathematics. Interviewees were selected by soliciting all academy members to participate, and interviewing all who volunteered. Interviews lasted approximately 30-45 minutes. The protocol was broken into sections asking students about their experiences in the academy and how they related to their current life and where they see themselves in the future. Additionally, there was a section of the interview devoted to asking students how the academy related to and/or changed their views on communication.

Themes that arose during open coding included:

- Teamwork
- Communication
- Professional Life
- Personal and Societal Responsibilities

In this section, we will overview what students had to say about teamwork and communication after the academy, which are relevant to the theme of this paper.

Teamwork

Each student had their own view on teamwork and leadership. For Patricia, being a leader is a means of effectively helping a team move towards a goal:

...leadership is basically a title, but how could I lead in a way that I'm not a dictator and everyone hates me, you know, I want to lead in a way that is something that everyone would want to follow me.

Through the academy activities, she found new ideas that she believes will help her be a person that people want to follow:

It was nice to look at leadership from a servant perspective and a service perspective, because that's not always a thing that's often spoken of when you're talking about leadership workshops. So that was really beneficial for me to practice that because being in a group of leaders, that's very different. Everyone's trying to learn how to work together when you have a lot of strong personalities.

Patricia mentioned the leadership style of servant leadership, along with the personality types that other people might have, as things to consider in being a more effective leader. She saw these as important because she thinks that being able to relate to others is of the utmost importance:

I want to learn how to interact with students and colleagues in a way that I can relate to them. So that I can get the best out of everyone I work with and I can give my best as well. Because sometimes it's hard to understand the standards of what they are expecting versus what you are expecting, and I don't want that confusion to lead to flaws in communication, you know.

For Tina, personality types were also an important tool for her to consider in teamwork:

...you could definitely tell the people that were, for example, the people who were action leaders, the people who are "go get 'em" that kind of stuff, um, but then, in situations where we were out on the course and everything, they have situations that you're put in that you have to respond to, and a lot of times, even the action people are like "well, maybe I'll just step back and let somebody else figure it out like that, so it's different even though you may categorize yourself as this one thing, how you respond in different situations.

Rebecca also saw personalities as an important consideration in leadership and teamwork for understanding those around her. Being on a senior design team and serving as the captain of the basketball team, she saw lots of application for those personality types:

Actually, so far, it's helped me with basketball. I'm not the type of player that had a good foundation with my coach in previous years, and I've been able to come to him in a respectable manner and, um, give my opinions, and we've been able to come up with ideas that suit not only me but the team, and that's really good because I've been able to, before the leadership academy I didn't know how to go about those things, because I saw him as one of the people for all their bad characteristics, and when they show what they really seem like, you say maybe he's this and not that, and so it also helped me with my senior design team, um, actually, we've been having kind of difficult places, and I've been expressing my feelings, and we've had, like, 5 design ideas, and we actually have been able to choose one design, and a lot of the aspects and the characteristics of the people I'm working with, knowing their personalities and actually acclimating towards them helped me figure it out and helped us get to a stage where in the design.

Teamwork and leadership were important considerations for all three interview participants. That personality types were mentioned, specifically, by all interviewees, is an indication that the activities associated with those may be particularly valuable.

Communication

The students who were interviewed note that communication is an essential skill for them now and in the future. Patricia noted:

The biggest thing is communication. There are too many times where plans fall through or things don't get done because there wasn't proper communication. And communication not just as in making contact and talking about it, but also understanding where someone else is coming from, because if we can motivate all of us to want to get the same thing done, it's a lot better. Like, when I've been in groups before, and everyone's been kind of dragging their feet, and I'm in that leadership position, pulling teeth to get stuff done. But if I can get an opportunity to get everyone excited to get the same thing done, it will be a lot better.

She also noted how the leadership academy experience, particularly the personality inventory, helped her figure out how to communicate with some people more efficiently:

It was a great refresher to talk about the personality colors [personality inventory where colors represent different personality types], I really loved that part of the program, because it takes a very complicated person and simplifies it to the point of where you kind of get the gist of why they are what they are. It's really great to see, even though we're a mixture of colors, by looking at their dominant [personality] color, you can recognize more clearly why they do what they do. And that's so excellent, because no person is just one color, also, if you understand that, like, my second color is blue, so I get along well with most of the other colors in general, but my favorite is that I'm very gold, so how can you work together and realize that, even if it's not their first color, how can you reach out to the part that you relate to in another person, like, I'm on a committee, I'm a

co-chair on a committee with someone who also did leadership academy, and she's primarily orange, which usually would drive me crazy, but her second color is blue. And so we connect on that blue level to get past the conflict between the gold and the orange. And so it's extremely helpful.

Patricia viewed communication as a foundational skill for working with others. Tina noted something similar, stating that communication “is what keeps everything running,” and that not having good communication is like having “a bunch of gears that don't fit together.” Before the academy, Tina thought communication was important, but her academy experience helped her realize it was potentially the most important skill for her. Similarly, Rebecca noted that communication was the most important thing in her professional development, and that the academy connected to developing that skill.

Discussion

In this paper, we have discussed the implementation and assessment of the Leadership Academy at Rose-Hulman. While the Academy is part of a larger, entrepreneurial learning program (KEEN), this paper has discussed ways that the Academy relates to communication, teamwork and problem solving, which are central skills not only for entrepreneurship and leadership, but in the development and assessment of engineering programs in general. In this section, we will discuss how the results of the academy assessment relate to each of those three skills.

Communication

In each assessment method used for this paper, communication was highlighted as an essential skill that students considered important *before* the academy and found new ways of approaching *after* the academy. Post academy surveys highlight that most students feel their communication abilities improved after the academy (more so than any other skill, see Figure 3). In interviews, each student noted the importance of communication, and how the academy either reinforced their notion of this importance, or in Tina's case, increased their perception of how important it was as a skill.

Both the ropes course rubrics and the reflective activity also helped to highlight the importance of communication, while providing information on strengths and weaknesses students had in communication. Both methods revealed that, when required to use non-verbal communication, students struggled. Students also struggled to communicate when multiple people had ideas at the same time, talking over each other on ropes-course activities. These struggles highlight ways that we could improve the academy in the future by discussing ways that students can deal with situations that are clearly more difficult for them.

In reflective activities and in post academy surveys and interviews, students noted that academy instruction on considering differences in personality through personality types helped them learn valuable lessons in communicating with people who have different perspectives. This information is valuable, in that it shows us that students consider academy instruction valuable in helping them improve their communication skill, one of the academy's outcomes.

Teamwork

Teamwork-related assessment results reflect some of our findings about communication. As with communication, post-academy surveys show that many students value understanding others through emotional intelligence and interpersonal skill, and feel that the academy helped them improve those skills (see Figure 3). In reflective short responses and interviews, students elaborate on the situations where they think teamwork skills will be valuable.

In the reflective activity and in the facilitator rubrics, the most common positive comment about teamwork was that students were encouraging of one another. This is potentially an attribute that students had prior to the academy, as the ropes course took place before much of the academy instruction, including the instruction on leadership traits. Reflections and rubrics also revealed that students took note of the fact that, in some activities, they had to go out of their comfort zone by letting others into their personal space (in activities that required physical contact). Future iterations of the academy, or other programs with similar goals, could take note of this and design some activities or instruction around working with others when outside of your comfort zone.

Rebecca, in her interview, discusses how the teamwork skills she learned in the academy--specifically in relation to understanding the needs of others through their different personalities--could help her in both her captaincy on the basketball team and in group work for projects. In short survey responses, other students reflected on how considering different leadership styles can affect the ways that they approach teamwork situations. The academy also influenced a significant number of students to be more likely to consider leadership a learned ability and less likely to consider it an innate trait. Beliefs that you have the ability to improve a skill (self-efficacy) are predictors to improving that skill²³. Once again, results from multiple methods help us understand the role that the academy played in helping students improve their teamwork skills.

Problem Solving

When problem solving was mentioned in reflective activities, surveys and rubrics, it was usually with respect to solving problems in communication and teamwork. As the academy focused on working with others, it makes sense that problems students remember solving are mostly those that involve communication and teamwork. In this way, responses about problem solving in this assessment seem tangential to communication and teamwork. For example, one of the problem solving weaknesses highlighted in rubrics was the lack of consideration of all ideas proposed due to issues with communication. On the other side of this, students reflected on using communication and teamwork as tools to solve problems they encountered, including the utilization of information they learned through academy instruction.

Assessment

While none of the individual assessment instruments utilized in for this paper were perfect, we believe this study shows the strength of utilizing multiple methods as a way of strengthening

assessments that would otherwise be difficult via the use of a single method. Through data triangulation²⁴ across surveys, reflections, rubrics and interviews, we were able to provide what we believe to be convincing evidence that activities at the academy had an impact on desired academy outcomes related to communication, teamwork and problem solving, and that academy instruction was valued in relation to those outcomes. We suggest that those who are looking to assess similar programs also consider utilizing multiple methods.

Conclusion

Through this paper, we hope to provide others who are considering implementing or assessing similar programs with ideas for both implementing communication, teamwork and problem solving workshops and potential methods for assessment of outcomes related to those topics. We have presented a Leadership Academy with multiple activity types and topics of instruction, as well as a multi-methods approach for the assessment of that academy.

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